DOCUMENT RESUME

ED 332 613 HE 024 575

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TITLE	Teaching Thinking in College. Accent on Improving College Teaching and Learning.
INSTITUTION	National Center for Research to Improve Postsecondary Teaching and Learning, Ann Arbor, MI.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO	NCRIPTAL-R-7
PUB DATE	90
CONTRACT	G008690010
NOTE	7p.
AVAILABLE FROM	NCRIPTAL, 2400 School of Education Building, The University of Michigan Ann Arbor, MI 48109-1259 (free with self-addressed stamped envelope).
PUB TYPE	Guides - Non-Classroom Use (055)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Cognitive Ability; Cognitive Development; College Students; *Critical Thinking; Higher Education; Problem Solving; *Skill Development; Student Improvement; Teaching Methods; *Thinking Skills

ABSTRACT

This paper discusses whether critical thinking can be taught in the college classroom. It argues that education in general provides the tools for thinking, and therefore, improves the capability for better thinking. The Alverno College faculty, as an example, has improved student critical-thinking ability because the faculty stresses explicitness, multiple opportunities to practice in differing contexts, and the development of student self-awareness and self-assessment. Teaching students to focus on the elements of a problem or to create a schematic or graphic representation are useful first steps to learning how to think. Also, student participation, teacher encouragement, and student-to-student interaction (active practice, motivation, feedback) are positively related to critical thinking. Courses in logic and laboratory procedures are not very successful in teaching practical reasoning skills, whereas statistics courses have been more useful by helping students to generalize. Three elements of teaching are highlighted as contributing to the improvement of thinking ability: (1) verbalizing methods and strategies to encourage development of learning strategies; (2) student discussion and interaction; and (3) explicit emphasis on problem-solving procedures and methods using varied examples. Contains 13 references and 8 suggested readings. (GLR)

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IMPROVING COLLEGE TEACHING AND LEARNING

Teaching Thinking in College

Everyone agrees that students learn in college, but whether they learn to think is more controversial. Part of the problems lies in defining thinking.

Thinking goes under a number of different names, such as reasoning, critical thinking, problem solving, and even creativity, depending on the discipline. Even a simple learning task, such as reading a textbook assignment, requires thinking. When faculty members talk about teaching critical thinking, problem solving, or reasoning, they typically refer to teaching students to use their learning in new situations to solve problems, reach decisions, or make evaluations. The kind of thinking depends on a student's knowledge and such cognitive processes as analysis, synthesis, and evaluation. The students also rely on metacognition—their ability to think about and monitor their own thinking activities.

Can We Teach Thinking?

Some would argue that we can only give students the knowledge necessary for thinking—that the intellectual ability required for thinking is innate, not teachable. Balke-Aurell (1982), however, has shown that general intelligence improves as students gain additional education. (Education also enhances verbal intelligence, and education in such fields as engineering and science enhances spatial and mathematical ability.)

One Success Story

In teaching critical thinking throughout their college, the Alverno College faculty (Loacker, Cromwell, Fey, & Rutherford, 1984) stress explicitness, multiple opportunities to practice in differing contexts, and the development of student self-awareness and self-assessment. Over four years of college, Alverno students showed growth in critical-thinking abilities, and personal development occurred, as demonstrated both on locally developed measures and on Stewart's *Analysis of Argument* (1977), the *Watson-Glaser Critical Thinking Appraisal* (1980), and Kolb's *Learning Styles Inventory* (1985).

Help for Novice Problem Solvers

The typical teacher—teaching problem solving in a discipline such as mathematics—may assume that the way to do it is to have students solve lots of problems. While this is not an incorrect assumption, teachers can probably do better by being more explicit about the specific methods and strategies that students can use. Working in thermodynamics, Elshout (1987) has found that beginners need to go through an orientation phase that involves bringing order out of chaos, discovering uncovered ideas, developing strategies, and avoiding jumping to conclusions. These findings suggest that problem-solving instruction for novices needs to differ from instruction for more experienced students. Learning

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how to represent a problem to themselves is a key task for all problem solvers, particularly for beginners as they try to tackle complex, confusing, or ill-defined problems. Teaching students to focus on describing the elements of a problem or to create a schematic or graphic representation may be a useful first step.

Talking the Problem Through

One of the critical elements in learning, retention, and transfer of problem-solving skills is verbalization. Ahlum-Heather and DiVesta (1986) showed in a controlled experiment that students who explained why they were taking a particular step as they practiced solving problems improved their performance. For these students the verbalization process was most helpful during the initial stages of learning.

Several programs designed to teach thinking skills to children involve a component of active discussion or dialogue as a way of giving student practice in thinking and verbalizing their thoughts. At the college level, Smith (1977) observed twelve classrooms in different disciplines and found that student participation, teacher encouragement, and student-to-student interaction were positively related to critical-thinking outcomes. These three elements fit with other research and theory emphasize the importance of active practice, motivation, and feedback in learning thinking skills as well as in learning other skills. Further, experiments with precollege and college students using measures of thinking or problem solving found discussion to be superior to lecture. And Fischer and Grant (1983) showed that in small classes, as compared with large ones, student responses showed greater use of analysis, synthesis, and evaluation—all important indicators of critical thinking.

Do Logic Courses Teach Critical Thinking?

Standard logic courses have not been very successful in teaching practical reasoning skills that transfer to settings outside those courses. In a study of student development during logic courses, Cheng, Holyoak, Nisbett, and Oliver (1986) found that only when abstract concepts were coupled with concrete examples and illustrations were students able to apply principles to new and different problems.

What About Statistics?

In contrast, training in statistics does help students make inferences about everyday events that they perceive to be subject to random variability. Even brief experience in the law of large numbers—either through giving rules or examples—helps students generalize, probably because they have intuitive ideas approximating the statistical abstraction (Fong, Krantz, & Nisbett, 1986; Nisbett, Krantz, Jepson, & Kunda, 1983).

What Can Laboratory Courses Add?

Many believe laboratory courses in the sciences teach problem solving. Although laboratory courses are effective in improving apparatus-handling skills or visual-motor skills, they generally are not very effective in teaching scientific method or problem solving unless those goals are especially emphasized. (Shulman & Tamir, 1973; Bligh, Jacques, & Piper, 1980). For example, in an inquiry-oriented physical science lab, Lawrenz (1985) used small-group interaction during a three-phase learning cycle of exploration, invention, and application. And Reif, Larkin, and Brackett (1976) used explanation, explicit training, and testing to teach problem-solving skills successfully in physics. Whether the laboratory is superior to the lecture-demonstration in developing understanding and problem solving skills probably depends on the extent to which understanding concepts and general problem-solving procedures are emphasized as opposed to "cookbook" methods.

What Are the Important Principles?

Our own research at NCRIPTAL in psychology and biology courses has shown that measures of thinking are related to the degree to which students have achieved an organized structure of concepts. At the same time, at least three elements of teaching seem to make a difference in student gains in thinking skills:

1. Verbalizing methods and strategies to encourage development of learning strategies.

2. Student discussion and interaction.

3. Explicit emphasis on problem-solving procedures and methods using varied examples.

Because productive thinking involves knowledge, it seems likely that this kind of teaching may be most effective in the context of subject matter courses. Our current research is directed at identifying strategies successful in teaching the distinctive and general skills in thinking involved in biology, English, and social science courses.

Suggested Reading

A number of scholars have applied current theories of cognitive psychology to programs for teaching thinking. Book-length programs have been developed by competent cognitive psychologists—Baron and Sternberg (1986); Bransford and Stein (1984); Halpern (1984); Hayes (1981); Nickerson, Perkins, and Smith (1985); Peters (1987); and Sternberg (1986).

—Kathleen A. Hart

References

Ahlum-Heather, M. E., & DiVesta, F. J. (1986). The effect of a conscious controlled verbalization of a cognitive strategy on transfer in problem solving. **Memory and Cognition, 14** (3), 281-285.

Balke-Aurell, G. (1982). Changes in ability as related to educational experience. **Goteborg Studies in Educational Science, No. 40**. Goteborg, Sweden: Acta Universitates Gothenburgensis.

Bligh, D., Jacques, P., & Piper, P. W. (1980). **Methods and techniques of teaching in post-secondary education.** Paris: UNESCO.

Cheng, P. W., Holyoak, K. J., Nisbett, R. E., & Oliver, L. M. (1986). Pragmatic versus syntactic approaches to training deductive reasoning. **Cognitive Psychology, 18** (3), 293-328.

Elshout, J. J. (1987). Problem solving and education. In E. DeCorte, H. Lodewijks, R. Parmentier, & P. Span (Eds.), **Learning and instruction: European research in an international context, Vol. 1** (pp. 259-273). Oxford/Leuven: Pergamon/Leuven University Press.

Fischer, C. G. & Grant, G. F. (1983). Intellectual levels in college classrooms. In C. L. Ellner & C.P. Barnes, **Studies of College Teaching.** Lexington, MA: Heath.

Fong, G. T., Krantz, D. H., & Nisbett, R.E. (1986). The effects of statistical training on thinking about everyday problems. **Cognitive Psychology, 18** (3), 253-292.

Lawrenz, F. (1985). Aptitude-treatment effects of laboratory grouping methods for students of differing reasoning ability. **Journal of Research in Science Teaching, 22** (3), 279-287.

Loacker, G., Cromwell, L., Fey, J., & Rutherford, D. (1984). **Analysis and communication at Alverno: An approach to critical thinking.** Milwaukee, WI: Alverno Productions.

Nisbett, R. F., Krantz, D. H., Jepson, C., & Kunda, Z. (1983). The use of statistical heuristics in everyday reasoning. **Psychological Review, 90**, 339-363.

Reif, F., Larkin, J. H. & Brackett, G. C. (1976). Teaching general learning and problem solving skills. **American Journal of Physics, 44** (3), 212-217.

Shulman, L. S. & Tamir, P. (1973). Research on teaching in the natural sciences. In R. N. W. Travers (Ed.), **Second handbook of research on teaching** (pp. 1098-1148). Chicago: Rand McNally.

Smith, D. G. (1977). College classroom interactions and critical thinking. **Journal of Educational Psychology, 69**, 180-190.

Suggested Reading

Baron, J. B., & Sternberg, R. J. (Eds.) (1986). **Teaching thinking skills: Theory and practice.** New York: Freeman.

Bransford, J. D., & Stein, B. S. (1984). **The ideal problem solver: A guide for improving thinking, learning, and creativity.** San Francisco: Freeman.

Halpern, D. F. (1984). **Thought and knowledge: An introduction to critical thinking.** Hillsdale, NJ: Erlbaum.

Hayes, J. R. (1981). **The complete problem solver.** Philadelphia: Franklin Institute Press.

McKeachie, W. J., Pintrich, P. R., Lin, Y. G., & Smith, D. A. F. (1986). **Teaching and learning in the college classroom: A review of the research literature.** Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning.

Nickerson, R. S., Perkins, D. N., & Smith, E. E. (1985). **The teaching of thinking.** Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Peters, R. (1987). **Practical intelligence.** New York: Harper & Row.

Sternberg, R. J. (1986). **Intelligence applied: Understanding and increasing your intellectual skills.** San Diego, CA: Harcourt, Brace, Jovanovich.

Tests/Instruments

Kolb, D. A. (1985). **Learning styles inventory and technical manual.** Boston: McBer and Company.

Stewart, A. J. (1977). **Analysis of argument: An empirically-derived measure of intellectual flexibility.** Boston: McBer.

Watson, G., & Glaser, E. J. (1980). **The Watson-Glaser critical thinking appraisal.** Cleveland: Psychological Corporation.

This **Accent** is based on the research of Wilbert J. McKeachie and Paul R. Pintrich and the staff of NCRIPTAL's research program on Classroom Teaching and Learning Strategies.

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NCRIPTAL, the National Center for Research to Improve Postsecondary Teaching and Learning, is funded at The University of Michigan by grant G008690010 from the Office of Research of the U. S. Department of Education's Office of Educational Research and Improvement (OERI/ED) and The University of Michigan. The opinions expressed herein do not reflect the position or policy of OERI/ED or the Regents of The University of Michigan, and no official endorsement by the OERI/ED or the Regents should be inferred.

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